Designing Online Games: Example and Application in the SAGE Project

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Abstract: A research and development program initiated under the aegis of the Centre for research of lifelong learning (SAVIE) developed a series of generic educational game design shells to enable teachers, trainers and community services workers to create educational games that provide effective learning conditions and are adapted to their distance learning needs. These environments were based on the frame game concept and on the essential attributes of games as compiled within the framework of the longitudinal *Simulations and Advanced Gaming Environments for Learning Project (SAGE)* research project. In this best practice, we will define the concepts of generic game shells. Then, an example will illustrate how a generic shell such as that of the Parcheesi Game can generate quality educational multiplayer games adapted to the needs of distance learners at various levels of schooling.

The framework of a longitudinal research project under the aegis of the Canadian network SAGE from the games and simulations unite about ten research teams. One of those teams, which is under the responsibility of Louise Sauvé, pays particular attention to the impacts that online educational games have on learning. Within the framework of this study, the team has developed a generic game shell that permits the development of educational games adapted to the learning needs throughout one's life.

The modeling of this shell relies on the concept of a "frame game" and on an analysis which permits to target the game components that are susceptible to provoke the desired educational impacts within the development of a generic environment of educational game conception.

This report will first present the problematic that underlies our developmental research. We will then define the concept of the generic game shell. Then we will illustrate how the structure of the game of Parcheesi has become a generic game shell. Finally we will present an example of an online game: *STI: Stopping Transmission*.

Problematic

Game Penetration in Households – An American survey reveals that 92% of young people aged from 2 to 17 have experimented with video games and that more than 2/3 of children aged between 2 and 18 are exposed to a video game system in the household (Kaiser Family Foundation, 2002). In France, 80% of young people aged from 13 to 17 have at least one computer in the household and 60% connected to the internet on a daily basis in 2006. In Canada, 63% of Canadians aged between 15 and 69 possess a cell phone (Ericsson, 2004) and use it regularly to play games. In Quebec, the NetAdos survey (Lamy, 2004) reveals that 60,7% of young people aged from 12 to 17 play online games and that 26,5% of young adults aged from 18 to 24 play regularly. A more recent Quebec survey (Alliance numériQC, 2005) shows that 67% of Quebecers live in a household with a computer and that 26% also own a game console (fix or portable).

Games in School. During the conference "Game developers 2006", Jerry Heneghan from the company Virtual Heroes mentioned that the market for educational games (or serious games) is gaining more and more ground in the world of game conception. The target audience of online educational games are principally those that we find in schools (elementary and high school), post secondary establishments and organizations (either public or private or even community organizations). What is happening in schools? Academic literature discusses a lot about the creative potential of new technologies such as educational games. What has been found, on the learning aspect, is that certain new aptitudes lay dormant when they are susceptible to being developed. It seems that schools do not

explore the educational potential of these new uses. In most countries, in Canada in particular, the educational potential of video games does not give place to any reality seen in the field (Piette, 2005; Prensky, 2005a, b). An inquiry of the European Union in media education (2006) draws up a report showing the chasm separating internet usage at home and at school. All the important functions for young people exist outside of school, just like the essential part of their learning process (learning by oneself or with people of the same age group), these functions are put into place by online educational games.

What is the Profile of Young People Using Games? Asakawa and Gilbert (2003), Bain and Newton (2003) and Prensky (2005a) suggest that "the game generation" has developed a new cognitive style characterized by multitasked learning, which is usually not paid much attention to during the learning process, and a way of learning which relies on exploration and discovery. They support that the introduction of games in the learning environment of this new generation will help and support the learning process. Saethang and Kee (1998) and Shaffer *et al*. (2004) say that the use of video games modifies the way young people learn and inspires itself from a constructivist approach: the student first plays, then comprehends and finally generalizes to apply what has been learned to new situations. The authors also affirm that the role of the traditional teacher and the role of students are equally transformed into a game context: the student becomes active and participates in the construction of his knowledge base and the teacher collaborates to this learning process. Oblinger and Oblinger (2005) describe the profile of today's adolescents: "born" communicators, intuitive and visual. They have strong spatial and visual aptitudes which are due most assuredly to their practice of video games. They prefer to learn through experimentation rather than following a teacher; they pass easily from one matter to another and also from one activity to the next when the activity does not offer great interest. They respond with promptness and demand a rapid answer in return. The young internet user wishes the following during the learning process: interactivity, interaction, active visualization, kinesthesis and immediacy. Van Eck (2006) adds that online games offer to the "Digital Natives" generation the opportunity to use inductive reasoning, to augment their visual abilities and their capacity to use many sources of information. The games allows the player to solve cognitive conflicts. "*Playing demands that you elaborate a constant cycle of hypotheses, of tests and revisions*"

How Can Games be Integrated into the Learning Process? An investigation by Kaszap *et al.* (2005), amongst teachers from New-Brunswick and from Quebec, specifies that educational games must take into account the qualities that the teachers are expecting from the offered online resources. O'Neill (2004) and Lamy (2005) indentifies that the online resources must be in direct link to the learning programs, they must be flexible so that they can be used efficiently in different learning situations, they must be adaptable to the particular characteristics (knowledge, level of language, etc.) of the students, and finally they must be friendly and easy to use. A study by Sauvé *et al*. (2005) of Web sites offering games has shown the following: (1) few games offer the learning content that answers to the pedagogical and technological criteria looked for by francophone teachers; (2) the existence of online games that deal with scholastic subjects, in particular mathematics and French (3) most online games demand long download times and sometimes they are expensive; and (4) few sites offer information on the acquired leaning gained through the games themselves.

In order to respond to the needs of the teachers concerning online learning through the use of games all while taking into account how young people learn , a generic game shell has been created from the framework of the game of Parcheesi.

The Concept of the Generic Game Shell

The concept of the generic game shell has been developed by Sauvé (Sauvé *et al*., 2002) from the concept of the frame game elaborated by Stolovitch et Thiagarajan (1980). By frame game, we mean that it is a means of teaching which comprises a structure that generates learning activities supporting the use of diverse strategies, implying a conflict and a set of rules for the movement of players and criteria that ends the game by declaring a winner. This structure can easily be adapted to many different objectives and pedagogical content. Any game can be broken down into two main parts:

- The structure determines the way in which you play: the rules, the steps for the course of the game, the movements of the players, the challenges the players must face and the strategies they must employ to win. We have emptied the game of its contents so that the unique structure of the game can be laid bare. This structure, once clearly defined and analyzed, becomes a "frame", or for the means of our research, a generic game shell.

- The content is the information conveyed in the game: in the case of a pedagogical game, it is also the objectives being pursued and the abilities that will be developed by practicing the game. When the game is elaborated, you only need to insert the new content accompanied by the predetermined objectives to generate a new educational game which is adapted for a particular target audience.

It is the structure which will form, in the educational game conception environment, the necessary components for its programming. All existing games are generic shell games but you have to analyze attentively the game in order to flush out the structure from the content. In general, board games are easier to adapt into a game shell. There are many reasons why we are interested in them for our research: (1) they are generally known by the public at large (Who has not played Snakes and Ladders, or Tic Tac Toe or even Parcheesi!); (2) they offer simple structures with few rules which makes them easily adaptable; (3) and more importantly they correspond to the notion of a game by distinguishing themselves from simulations or game simulations since board games are constructed from the imaginary rather than from reality. Let us examine how the team has adapted the frame of the game of Parcheesi in order to make a generic game shell.

The Adaptation of the Frame of the Game of Parcheesi

The Web site of The Educational Games Central already proposes five generic game shells (http:/carrefour-jeux.savie.qc.ca) in three languages (French, English and Spanish). To develop a sixth game shell, the team relied upon an adaptation of an interactive pedagogical design model of McGriff (2000). Testing methods included expert internal validation and also a sampling of a target population as developed by Bordeleau and Perron (1994) and validated for online games by Sauvé et al. (2002) during the development of generic educational game shells. Let us examine how the game of Parcheesi has been adapted to become a generic game shell.

Structure Adaptation

First of all, we identified the original structure of the game of Parcheesi. Many adaptations were made in order to include pedagogical aspects and to make it into a generic game shell (http://egc.savie.ca); in particular, the game board, the rules, the directions, the learning activities, the pedagogical materials and the debriefing.

In general, the game board is rarely modified in a generic shell. In this case, we have taken into account the pedagogical demands and we have added a second route, which is much faster, to the initial route of the game board all while maintaining the number of spaces and the square shape of the board. The materials of the game, the number of pawns for each player or team (4) and the number of dice (2) is maintained. *Learning* cards (integration of the learning content), *Team* Cards (all teams play at the same time) and *Chance* cards (randomness to increase or diminish the chances of winning the game) have been added to answer to the learning objectives and maintain motivation.

The rules which govern the movements of players in the game have been improved. The *procedure* rules describe the components of the game: the number of participants (players) or the number of teams, the role of each participant, their activities, the way they move and their possible movements, how the game starts, how the players proceed throughout the game, the scoring and the duration of the game. In our adaptation, we have added the following rules: 5 to 8, 10,12 and 13 which deal with the actions of the players during learning activities and the movement of the pawns between the normal and rapid route.

The *end* rules explain how the game can be won and how the game ends. Generally, the end of the game determines a winner; however, there are certain games where there can be a draw. In Parcheesi, the end of the game happens when a player or team have completed the route. We have added a second way to end the game in order to respect the time constraints of a study period and this is shown by rules 2 and 14 of the adapted version. The rules of *control* describe the consequences for a player who executes an action which does not conform with the rules or a player who does not respect the directives and the preceding rules. In the shell of Parcheesi, we did not have any *control* rules link to the original structure but we have added movement constraints to the pawns, as shown in rules 5 to 7, when a team does not successfully pass a learning activity.

In board games, there are no distinctions between the rules and the directives as in computer games. In a board game the players themselves move their own pawns on the board. In a computer game, a game engine moves the pawns, identifies which player will start the game, the player who follows, etc. These directives, that we distinguish from the rules, only have as a goal to facilitate comprehension for the players on the constraints imposed by a game engine. For example, it indicates the name of the player that must click the dice or the player that must attempt a learning activity in order to obtain points, etc. No other player can act in the game until the identified player has finished their turn.

Finally, this shell allows for the generation of team games supported by a multiplayer platform (ENJEUX, http://enjeux.savie.ca) and also provides real time communication tools (audio or videoconference) according to the equipment that the players possess (headphones or webcam) at the moment they access the game.

Content Adaptation

In general, the content of a game is completely modifiable. First of all, we have added learning activities to the shell in order to respond to certain demands previously stated. The predetermined formats linked to eleven types of activities have been integrated and are presented in the form of closed questions (multiple choice, True or False) and open questions (long or short answers), illustrated exercises, audio or video, cases to be analyzed, logical sequences to be completed, etc.

Other tools have also been integrated into the shell. Tools for pedagogical material conception in the form of learning objects. This material is available for players either before or after the game. The creator of the game can activate a whiteboard for debriefing and also for feedback from the players. This debriefing is strongly recommended because it is an important step to the integration of the knowledge, emotions and attitudes developed by the game.

Ultimately, the generic shell of the game Parcheesi proposes to the creators all the tools necessary to define the game parameters, generate the directions and the rules concerning the movement of players, constructing learning activities and the pedagogical materials, establish the criteria about how the game ends by declaring a winner and the elaboration of debriefing and evaluation instruments so that the game is always revised and measure its effectiveness on learning.

An Example of an Online Application

Starting with the shell game of Parcheesi, two medical doctors[1] associated themselves with the research team to develop a game on sexually transmitted infections. They have developed 73 learning activities which are grouped into four aspects of STI (Fig. 1): (1) prevention : information on the correct ways to break the cycle of STI transmission (types of condoms, identification of risky behaviours, etc.); (2) prevalence: the state of the situation of the importance of the number of people infected or carriers of an STI, and information on the infectious vectors themselves (their nature, their visible or invisible effects); (3) transmission of STI : information on how the different types of STI can be transmitted. This category allows the players to question the widespread myths and beliefs already well anchored in the population at large and (4) treatment: information on the ways to heal (or coping with) sexually transmitted infections. This section also includes information on ways to prevent transmission to other people when you are infected; for example, abstaining from certain types of more risky behaviours during the treatment period and also information on what to do when you think you have been exposed to an infection. To these questions, the research team has added about 20 role-playing activities which permits young people to express and reflect on STI which will modify their attitudes and behaviours on a daily basis. (Fig. 1) illustrates an example of an activity that includes a viewing of a video clip:

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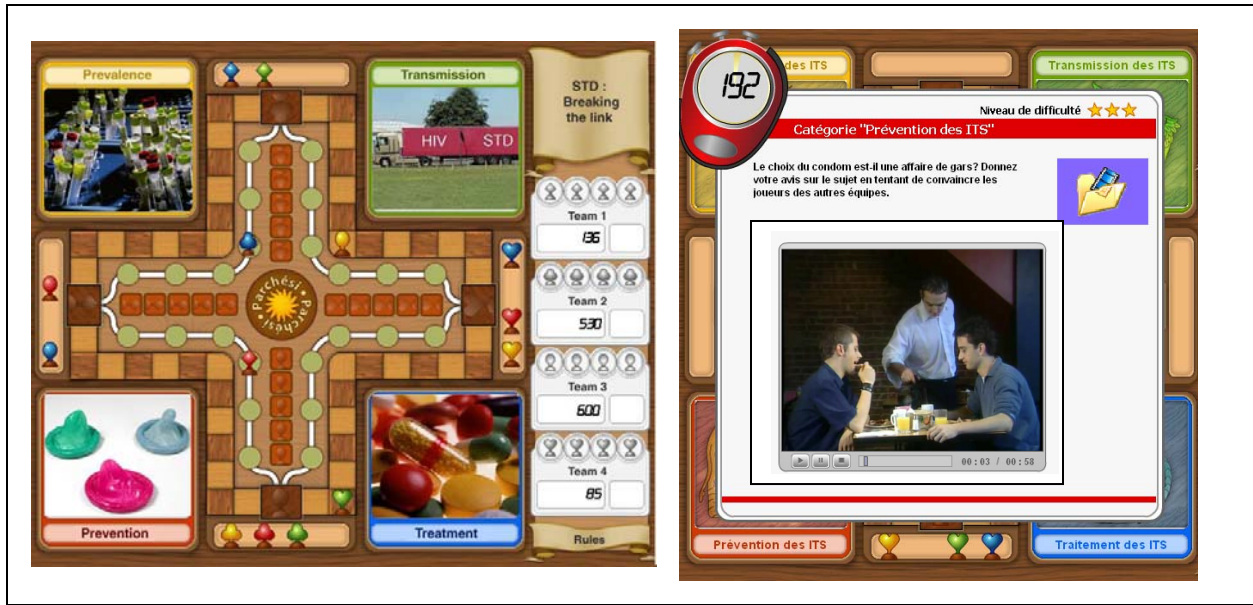
Figure 4: An example of an activity with a video clip

Conclusion

Being pioneer work in the development of generic shells for educational games on the Internet (6 shells are now available), this developmental research, under the aegis of the Center of expertise and research of SAVIE and the SAGE network, gives the possibility to health professionals to rapidly develop educational games which will be available to both teachers and students in Canada as well as all around the world. To know more and to become part of these game creators, register yourself at SAGE: http://www.sageforlearning.ca/ and at The Educational Games Central at the following Internet address: http://egc.savie.ca.

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